

Special Feature

Technology cannot be viewed as a separate entity within either the military or society in general. This illusion of discreteness simply does not exist. It is and will remain an integral part of both. The real issue is to recognize that technology is a tool with limitations, and these limitations should be considered in reacting to particular situations.

21st century logistics

Future UAV Pilots: Are Contractors the Solution?

RFID Technology: Is the Capability a Boon or a Burden for DoD?

Two evolving facets in the fabric of military logistics—technology (to include technological change and technological innovation) and the increasing use of contractors covers a lot of ground and often enjoins heated debate. Each has been looked on as a major tool for dealing with problems seen at the end of the 20th century and now in the 21st century. Recent changes—order of magnitude changes—in technology have led to both long-range and strategic planning efforts that integrate current and future technological advances into operational concepts. Similarly, the military has been expanding the use of contractors and contractor support into quasimilitary areas.

One such area is operating and maintaining unmanned aerial vehicles (UAV). In the first feature article—in the edition of the *Journal*, the authors examine several of the key issues associated with UAV operations—predeployment training, combatant status, and command authority. In the second feature, one particular aspect of technology is examined—radio frequency identification (RFID). From a Department of Defense perspective, the authors argue that RFID technology must be harnessed to ensure sustainment systems are able to support military forces in the transformation environment. They also examine the challenges associated with implement RFID technology.

Introduction

Special Feature

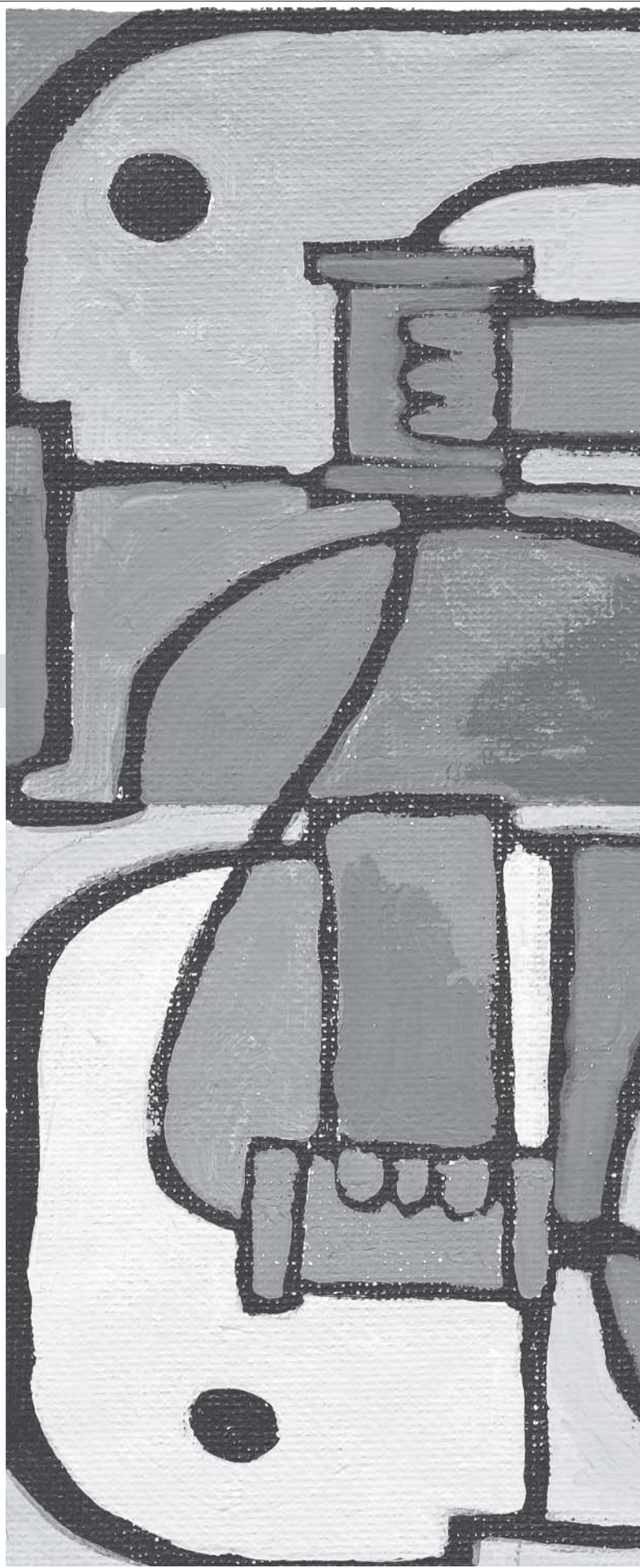
The Department of Defense (DoD) is in the process of transforming the Army, Navy, Marines, and Air Force into leaner and lighter warfighters to prepare for a myriad of challenges that may face the United States in the years to come. Along with these changes to its military forces, the DoD is designing, developing, and

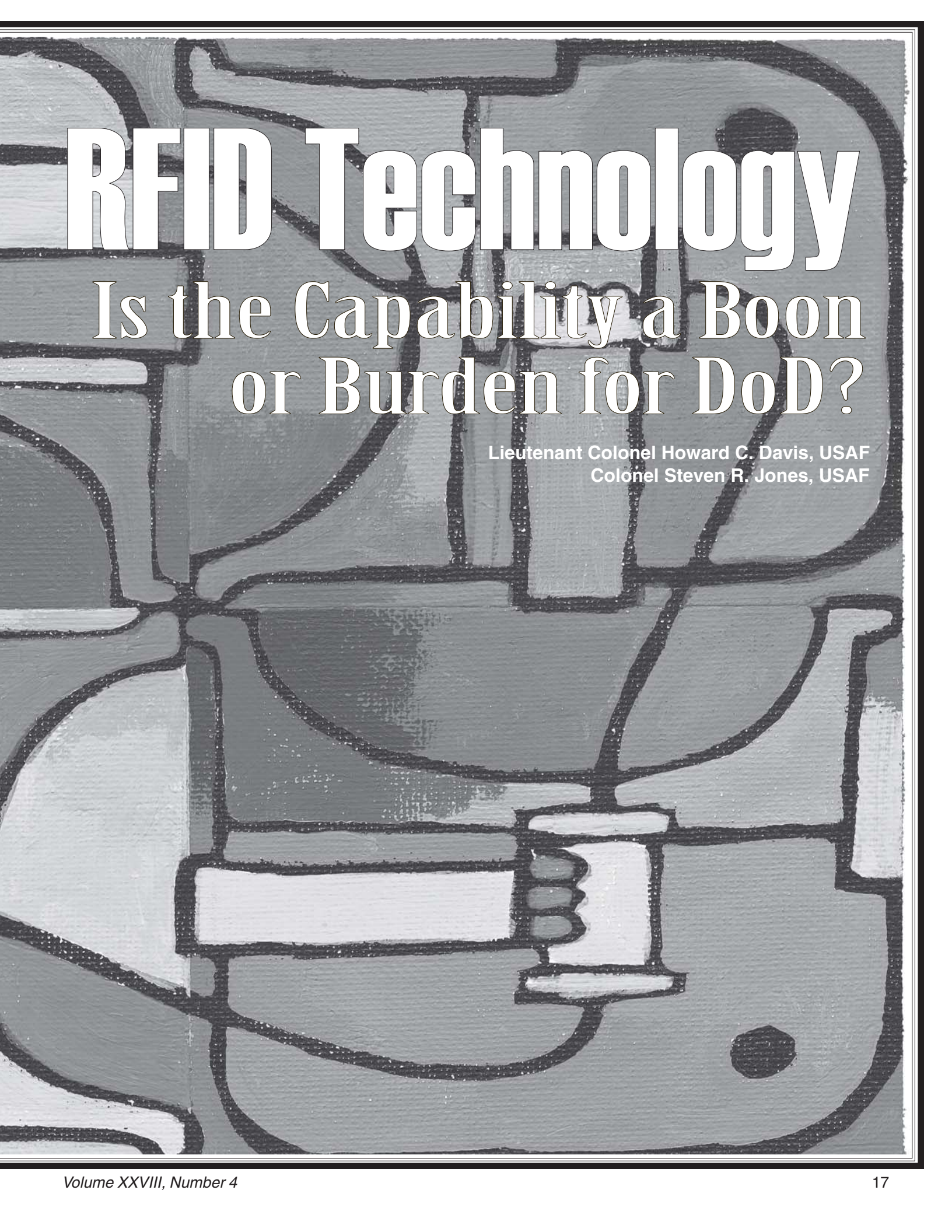
incorporating the necessary capabilities to enhance its logistics support systems so that it can ensure the timely sustainment of its transforming fighting forces. For logisticians, the requirement to provide timely support to the warfighters means the DoD's logistics supply chain will need to transform the tools it uses to support all the military services.

Radio frequency identification (RFID) is a Logistics Transformation tool the DoD can use to provide valuable insight into the DoD supply chain and ensure the United States that

leaner and lighter military forces are combat-ready when required to protect the country's national interest. The valuable insight that RFID technology can provide is termed Total Asset Visibility (TAV). Total Asset Visibility is envisioned in the DoD's Joint Vision JV 2020 plan and Joint Chiefs of Staff (JCS) Focused Logistics concept as a capability that can enable the DoD to transform the military into lighter and leaner force packages for future conflicts. RFID technology provides DoD logisticians the capability to identify, categorize, and locate assets automatically. As users of TAV information, US Transportation Command (TRANSCOM), Air Mobility Command (AMC), and the warfighting combatant commanders can benefit significantly from RFID technology, because RFID can provide insight into the movement of cargo during major theater war and contingency operations. At the same time, the Defense Logistics Agency (DLA), the organization responsible for integrating RFID capabilities within the DoD, can benefit financially by integrating RFID technology to lower the quantity of its sizable inventory.

RFID technology used within the DoD today has been very beneficial. However, because RFID is a fairly new technology, the current DoD RFID system is obsolete, and RFID industry wide is nonstandard and noninteroperable. To meet the myriad of challenges that may face the United States in the future, today's RFID technology shortfalls must be corrected. Like the DoD, the commercial industry has learned the benefits of using RFID technology and is using it throughout supply chains to automate inventory and for movement of items. So the question is, can the DoD benefit from commercial industry's pursuing RFID technology to correct current RFID technological shortfalls?





RFID Technology

Is the Capability a Boon or Burden for DoD?

Lieutenant Colonel Howard C. Davis, USAF
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RFID and DoD's Transformation

If we do not change the direction we are going, we will end up where we are going.

—Chinese Proverb

The end of the Cold War forced the Armed Forces to institute a tremendous change in the country's National Security Strategy. After years of having an identifiable and quantifiable threat, the DoD's post-Cold War military strategy drove the Armed Forces to become smaller and more mobile. In light of these changes and as a result of lessons learned during military operations since the end of the Cold War, future US military operations will employ a smaller, highly mobile armed force that will face an uncertain enemy. World changes have forced the development of a more flexible National Security Strategy, and each of the Services within the DoD is posturing to predict the right mix of combat capabilities for an uncertain future.

The DoD has termed the transition to the right mix of military capabilities as *transformation*. This transformation has been defined by the Air Force as:

...a process by which the military achieves and maintains advantage through changes in operational concepts, organization structure, and/or technologies that significantly improve its warfighting capabilities or ability to meet the demands of a changing security environment.¹

support improvements.² Focused Logistics as defined by the JCS-J4 Logistics Directorate is:

...the fusion of information, logistics, and transportation technologies to provide rapid crisis response, to track and shift assets even while en route, and to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical levels of operations.³

The ultimate goal of the Focused Logistics concept is to provide an umbrella of logistics capabilities to guide the transformation of the Armed Forces into the future. Given the Focused Logistics concept is the logistician's guide for the future, it is important to identify the subconcepts that link RFID technology capabilities to the future vision of logistics sustainment.

As a supporting document to the Focused Logistics concept from the JCS, the Focused Logistics campaign plan was developed to address how the DoD should transform its logistics sustainment systems, processes, and organizations to support the warfighting combatant commanders in future military operations.⁴ In essence, the Focused Logistics campaign plan articulates how logisticians and operators can work as partners to provide the military fighting forces the capabilities and benefits of Focused Logistics. Within the campaign plan, Logistics Transformation is identified as a building block that will help lay the foundation for the Focused Logistics concept

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Even if the individual military services manage to hit upon the correct capabilities and combat mix—the right transformation concepts—there remains a single challenge that will affect mission success for the entire DoD in future military operations. That challenge lies in the performance of the DoD's logistics support systems.

To ensure successful logistics support in future military operations, the DoD developed the JV 2020 plan, which is intended to be the DoD strategy that will guide the movement of the Armed Forces into the uncertain future. Prior to JV 2020, a number of today's Cold War-era logistics systems were developed to provide support against a known and predictable threat. These archaic systems were designed to depend on large quantities of supplies and equipment being stockpiled in an overseas location. These locations were well-known by the warfighters and were in locations where training had taken place. In today's post-Cold War environment, the logistics support systems of the past have to be modified. The DoD's logistics support strategy must include forward basing with the right amount of supplies and equipment, which means no under or over supply.

The real challenge for the DoD is to improve the logistics support capabilities for its smaller, mobile, and joint forces that will be required to engage in missions around the world. Ultimately, the DoD will employ one of the six concepts of JV 2020, Focused Logistics, to guide the Armed Forces to logistics

to succeed.⁵ The plan suggests that the transformation of logistics has started already and that the foundation that establishes the capabilities of Focused Logistics rests on a pillar that provides DoD senior leaders a view into the logistics sustainment system; that pillar is Total Asset Visibility. Total Asset Visibility is envisioned to provide logisticians visibility into all assets in the logistics support process—those either being acquired or in maintenance, storage, or transit.⁶ Total Asset Visibility is an initiative that can provide future joint warfighters real-time, logistics situational awareness.

As an enabler of Total Asset Visibility, automatic identification technology (AIT) is a mechanism that can be used at critical nodes in the logistics supply chain to provide efficient and effective logistics data collection. AIT is the name given to devices used to automate data collection. The goal of AIT is to provide cost savings within the logistics support process by using automated means to collect logistics data. The Air Force AIT vision states:

The Air Force should have accurate and timely information available to decisionmakers in 2005, whether Air Force, joint, or coalition—through the exploitation of AIT-capable information systems where source data are captured at the home base, so that deployed forces will no longer have to accomplish data collection manually.⁷

To sum it up, AIT is a mechanism that will help the DoD logistics community achieve the Focused Logistics

concept TAV objective—total visibility into the logistics support process.

As the Focused Logistics campaign plan mentions, AIT is critical to Logistics Transformation, and the need to ensure integration of the supply chain is one of the key functions required to shape the future logistics environment.⁸ Supply chain integration is a task that falls under the main task of Supply Chain Management (SCM), which covers all actions accomplished throughout the supply chain. SCM is defined in the *DoD Supply Chain Management Implementation Guide* as:

...an integrated process that begins with planning the acquisition of customer-driven requirements for material and services and ends with the delivery of material to the operational customer, including the material returns segment of the process, and the flow of required information in both directions among suppliers, logistics managers, and customers.⁹

Commercially, a supply chain is defined as, “An association of customers and suppliers who, working together yet in their own best interests, buy, convert, distribute, and sell goods and services among themselves, resulting in the creation of a specific product”¹⁰ Merging the definitions to the lowest level, SCM is the means of integrating the activities of the supply chain to optimize cost and performance and reduce the time between ordering and delivering a product.

The reason RFID technology is key to SCM and Total Asset Visibility is that RFID technology can be used as an AIT tool, an *enabler*, a means to carry and retrieve data by electronic means, and to identify items in manufacture, in transit, and at locations.¹¹ RFID technology can provide logisticians the capability to identify, categorize, and locate assets automatically throughout the DoD’s logistics supply chain. RFID can provide a capability that has been termed in the DoD as intransit visibility (ITV). RFID technology is a key to the DoD’s Logistics Transformation efforts, because enabling RFID technology can ensure the Focused Logistics concept and the JCS JV 2020 plan for the future become a reality within the DoD. RFID technology is critical to current and future military operations because, in the best case, logisticians will be able to tell that the supplies are where they are required, and in the worst case, if the supplies are not where they are supposed to be, logisticians will know where they are.

RFID in the DoD Supply Chain

We are witnessing a revolution in the technology of war, power is increasingly defined not by size but by mobility and swiftness—influence is measured in information....

—Governor George W. Bush

It is important to understand how RFID technology is linked to the DoD’s plan for transforming its forces and logistics support systems, and it is equally important to understand the types and capabilities of RFID technology. RFID technology offers a fairly new approach to collecting information, by providing the capability to identify, categorize, and locate people and assets automatically over short and long distances. An older and, maybe, more familiar approach to an electronic information collection system is the universal product code (UPC) or bar code. UPCs and bar codes have been around since the 1970s, but the technology is limited. It only has a capability to store 17-20 characters of data.

Article Highlights

The DoD should harness the capabilities of RFID to ensure its logistics sustainment systems will be able to support its transforming military forces.

To sustain the US military’s lighter and leaner warfighters, logisticians are planning to integrate capabilities into the DoD’s supply chain that will provide asset visibility, while at the same time provide financial savings. RFID technology is a capability that can ensure the fighting forces will be efficiently sustained during the myriad of challenges that may face warfighters in the future. Integrating RFID technology can provide warfighters and logisticians total asset visibility into the DoD’s supply chain and afford the DoD substantial savings by reducing its sustainment inventory. RFID capabilities should not be looked at as just another so *what—sounds good* idea that will burden combat operations. Ultimately, the capabilities provided by RFID technology will benefit the entire DoD.



Figure 1. Linear Bar Code

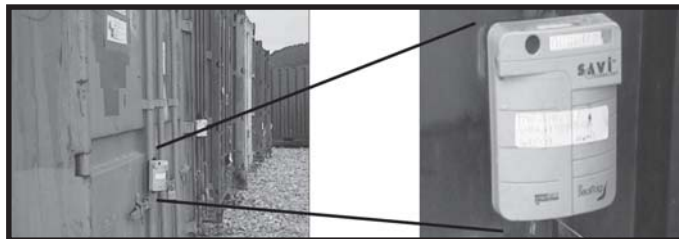


Figure 2. Active RFID Tag (Tag Attached to a Storage Container and Tag Close Up)



Figure 3. Portable RFID Reader and Active RFID Tag

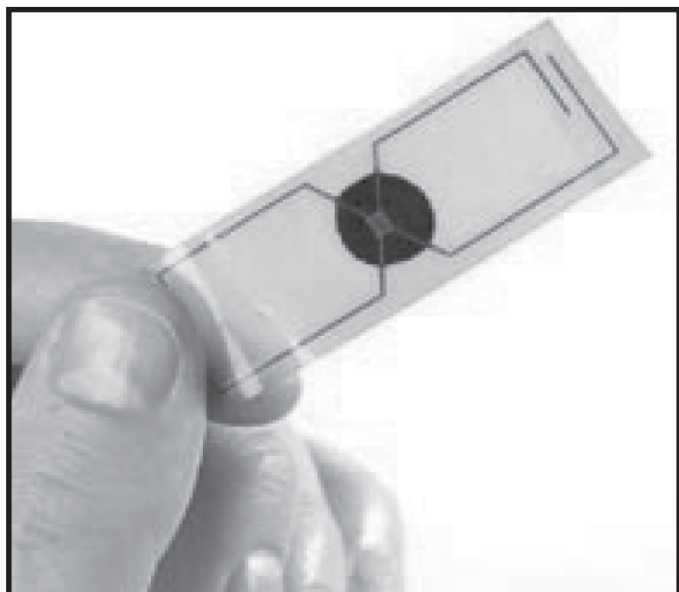


Figure 4. Passive RFID Tag

Additionally, bar codes require scanning, which means they require line-of-sight access for optical recognition (Figure 1).¹²

RFID technology uses radio frequency (RF) communications to transmit and receive data, and the technology is based on the ability to collect, store, and retrieve data remotely on a tag using RF communications. RFID technology is based on an electronic product code (EPC), “a 96-bit code that is capable of identifying more than 80 thousand trillion, trillion-unique items.”¹³ There are two parts to the RFID data collection system, a tag and a reader. RFID tags can have one or several memory chips for data storage, a circuit board structure for its electronic components, and an antenna to send and receive information using RF communication capabilities.¹⁴ Tags can range in size from that of a grain of rice to that of a brick. As the second part of the RFID data collection system, the RFID reader communicates with RFID tags using RF energy. The RFID reader uses an RF signal to initialize the tag, and the tag then transmits information back to the reader using RF energy. The reader also can write information on the tag. Written information can range from as little as a serial number to kilobytes of data both written to and read from the tag.¹⁵ Information from the tag, after being read, can be presented to a human operator using a handheld device with an alphanumeric display, or the information can be entered into a larger computer system that provides data management for a large organization.

The types of RFID tags can vary. They can be active (Figures 2 and 3) or passive (Figures 4 and 5), which refers to the method of powering the tag. While both active and passive tags use RF energy to communicate with the reader, the technology of powering the tags and capabilities of each of the tags is quite different. With respect to power, active RFID tags use an internal power source to continuously power the tag and its RF communications circuitry. On the other hand, passive RFID tags rely on RF energy being transferred to the tag from a reader and the reader’s power then providing the capability to read or write data. Capabilities for each of the tags vary in communication range, the amount of data storage, and in the tag’s capabilities to monitor and record specific parameters. Active tags can be read at ranges up to 100 meters and at speeds in excess of 100 miles per hour. They have the capability to store a minimum of 128,000 bytes, 1 million bits of dynamically searchable read-and-write data, and because active tags are constantly powered, they have the ability to detect a parameters condition continuously. Parameters can include temperature, vibration, and security status, to name a few.¹⁶ Passive tags can be read at a range of 3 meters or less and at speeds up to 3 miles per hour. They typically have the capability to store a maximum of 128 bytes, 1,000 bits of read-and-write data. They do not have a data search or manipulation capability, and because passive tags are not powered by a battery, they are unable to detect parameters.¹⁷ One of the biggest differences in the two tags is that active tags have a limited life cycle because of their internal battery, while passive tags have a virtually unlimited life.

The DoD’s supply chain can benefit from both active and passive RFID to enhance supply chain visibility. However, because of the technological differences between the two types, there are benefits of using one type over the other. Active RFID is best suited for dynamic business processes, where the movement of tagged assets is variable and sensing and increased data storage capabilities are required. Passive RFID is best suited

for use with items where the movement will be fairly consistent and controlled and minimal data storage capability is required.¹⁸

Within a supply chain, either active or passive technologies can prove beneficial, and in some cases, the use of both types of RFID can be of benefit. For example, using RFID technology, it is possible to embed a passive RFID tag into a manufactured item and have the tag read and written to during the manufacturing process to gather and exchange work process data. The same tag then could be read or written to by shipping personnel at the manufacturer's shipping dock in order to release the item from the manufacturer's inventory. While at the shipping dock, the item's planned route information could be written onto the item's tag and read by a reader that enters the item's information into a company's management information system for a variety of purposes, including logging the item's manufacturing data or tracking the item's cost to build or current location. Prior to a large number of items being shipped, information for each item can be written to an active RFID tag that is placed on a shipping container or pallet. The recipient of the containerized or palletized items can be aware of the current location of the items at all times, using a management information system, and the item's location can be updated while in transit as the active RFID tag passes nodes along the transportation route, which are linked to an automatically updated information system database. The preceding scenario provides a simple example of how RFID technology can be used; now it is important to understand how the DoD actually is using RFID technology, the plan for future use of RFID technology, and the challenges that exist in the RFID technology arena.

Intheater processing of containers also presented a major headache, for a number of reasons. One big contributing factor was multiple consignees for a single container. This resulted from the eagerness of our stateside, European, and Korean shippers to fill every container to the brim, which would ensure every ship was filled to capacity. Given our limited shipping capacity, this made good sense—at least until those ships disgorged their cargoes in Saudi Arabia. Then it turned into a classic example of suboptimization.²⁰



Figure 5. Passive RFID Memory Button

As a result, during the Gulf War, the United States shipped approximately 40,000 containers of supplies and equipment to support military operations. Throughout the war, these containers, which contained everything from food to ammunition, amassed on the docks of the Saudi Arabian port. Since receiving personnel could not determine what was in them, they had to be opened and inventoried prior to distribution. This resulted in a bottleneck in distribution. As Pagonis points out:

We had numerous mixed loads and even a larger number of unidentified containers. The documentation on the ship's manifest didn't always jibe with what was in the containers. We had to open

The DoD's supply chain can benefit from both active and passive RFID to enhance supply chain visibility.

Analysis

In the 21st century, technology will make it possible to find, fix or track, and target anything that moves on the surface of the earth.

—General Ronald R. Fogleman, USAF

Current Use

When General Fogleman, former Chief of Staff of the Air Force, made the statement above, he was referring to the ability of the Services' combat forces to engage an enemy's force anywhere on the surface of the earth by using advanced information technology. A similar hypothesis is envisioned by logisticians—using technology to find, fix, track, and target anything that moves within the DoD's supply chain. The Persian Gulf War has been called the impetus behind the use of RFID technology in the DoD.¹⁹ There are two experiences from the Gulf War that drove the logistics community to recognize the need for RFID technology and, finally, implement its capabilities.

The first experience occurred because US military forces were plagued by several logistics inefficiencies during the Gulf War. As the head logistician during the war, Lieutenant General William Pagonis acknowledged that knowing what was in shipping containers proved to be problematic.

some 28,000 of the 41,000 arriving containers right there on the docks just to find out what was in them. We hauled a lot of containers 2,000 miles out into the desert only to find that 10 percent of their contents were intended for the front-line troops, whereas 90 percent belonged to units back near the port.²¹

Because the supply system was not able to get supplies and equipment to units when needed, supply personnel began ordering more of what was needed, hoping that a reordered item might make its way to the unit; as a result, multiple items clogged the supply lines even more.²² By the end of the Gulf War, "8,000 containers stood on the docks unopened. No one knew what was in them or whom they belonged to."²³

The second experience occurred because the short duration of the Gulf War created large stockpiles of unused ammunition. Following the end of the war, the United States had a huge stockpile of *live* weapons located in Saudi Arabia, "We had something like 250,000 tons of ammunition sitting there in the desert, waiting to be packed and sent home."²⁴ The large numbers of unopened shipping containers from the first experience made logisticians take notice of the considerable problem the DoD had with ITV. In the case of the shipping containers, they could be returned to the point of origin; however, in the case of the large quantities of palletized ammunition, the Army had to redeploy and keep track of the valuable assets movement throughout the

DoD's supply chain. To provide ITV of the retrograde ammunition from the Gulf War through Europe, the Army first began using active RFID tags in late 1991 and early 1992.²⁵ After the retrograde of the Gulf War ammunition proved successful using RFID tags, the US Army Strategic Logistics Agency (now the Army Logistics Transportation Agency [LTA]) requested the DLA conduct a test to identify an active RFID tag the Army could use to track certain Class IX repair parts, shipped to and from designated overseas customers.²⁶ Beginning with its use in 1991-1992 and since the DLA test in 1993, the Army has pursued the long-term use of active RFID tags. In an agreement with DLA, the Army procured and furnished active RFID tags to DLA so that tags could be affixed to Army pallets and containers for exercises, contingency operations, and routine shipments. In the scenario, the Army LTA owned most of the DoD's RFID technology assets, which included stationary and handheld readers and writers, tags, magnetic mounting brackets, and remote ITV servers.²⁷ Fourteen of DLA's distribution sites were instrumented to store data and generate software for active RFID tags for Army shipments; and DLA's biggest container consolidation points at New Cumberland, Pennsylvania, and San Joaquin, California, were outfitted to tag consolidated DoD shipments headed for Europe, Central Asia, the Middle East, and the Pacific.²⁸

Now, with an understanding of why the DoD began using RFID technology and who manages RFID within the DoD, it is important to point out how the DoD is using RFID technology. Twelve years after experiencing the severe supply inefficiencies of the Gulf War, the DoD is using active RFID tags to achieve ITV of assets throughout the supply chain. RFID technology has been installed around the world by the DoD to determine the location of containers and pallets and provide supply chain visibility into the contents of items in transit. RFID readers are located at airports, airfields, distribution centers, assembly areas—these nodes have been established throughout the world to read active RFID tags attached to DoD pallets and containers. RFID readers at the various nodes in the supply chain *read* the active tags and transmit the information to local ITV servers. These local servers provide database storage and transmit the collected data to centralized regional servers.³³ Currently, regional servers are located in the European Command, Pacific Command, and CENTCOM; these servers are connected to a national ITV server in the United States, which acts as a data source for the DoD's global asset visibility system called Joint Total Asset Visibility (JTAV). For transmission of data from remote locations without local or regional connectivity, logisticians can use Iridium satellite terminals as modems to relay the pallet and container data to the national ITV server.³⁴ JTAV is linked to another DoD system, the Global Transportation

RFID is a relatively new automatic data-collection system, and like many computer technology-based systems, the technology is changing rapidly.

Fast forwarding to 31 July 2002, the combatant commander of US Central Command (CENTCOM) directed that all containerized shipments being sent to the CENTCOM area of responsibility be RFID tagged.²⁹ As a direct result of the commander's decision, the DoD had the ability to track all support items shipped on pallets and in containers to the area of responsibility. As an indirect result of the decision, the need for RFID tags increased significantly. To meet the need, the Army initially increased the number of active RFID tags purchased to cover the additional Operation Enduring Freedom requirements. Then, at the beginning of Operation Iraqi Freedom, CENTCOM issued a requirement that all containers and pallets sent to CENTCOM's area of responsibility in support of Enduring Freedom and Iraqi Freedom be RFID tagged—regardless of the service.³⁰ The Army realized the significant increase in RFID required to meet this new requirement, and in February 2003, the Army went on record to request it not be held responsible for providing RFID tags to all the Services. Additionally, the Army asked DoD to recommend a solution to resolve the active RFID-tagging problem.³¹ DLA was and still is identified as the office with management responsibility for RFID technology within the DoD. As a result, DLA selected the standard active RFID tag for use in the DoD and put wholesale management in place to control the purchase, issue, and refurbishment of the standard tags.³²

Network (GTN); both JTAV and GTN are available to DoD personnel who use the World Wide Web to track and determine an item's location.³⁵

The following scenario is provided to describe how active RFID capabilities are used when items are shipped within the DoD. Items being shipped in containers and on pallets are recorded on an active RFID tag, and the tag is placed on the outside of the shipping container or on the pallet. Simultaneously, the item's information stored on the RFID tag is sent to an ITV server to enable shipment tracking. As the RFID tag passes through various transportation nodes, ground-based or handheld readers collect the tag's information; this information is downloaded automatically; and the tag's ID, location, and date-time group are forwarded to the national ITV server to report the tag's current location.³⁶ RFID technology provides the DoD and ITV capability now, and these capabilities are a step in the right direction in correcting past supply problem inefficiencies. RFID technology is currently in use, and the DoD has a plan to utilize even more RFID capabilities to enhance the DoD's logistics capabilities.

Future Use

A recent presentation by the JCS Directorate of Logistics identified RFID technology as a key logistics ITV enabler of Iraqi Freedom.³⁷ The CENTCOM-mandated ITV RFID capability gave

the DoD the capability to track food, spare parts, vehicles, medical supplies, ammunition, and construction materials, and “ground-based readers provided near real-time ITV of contents on ships, trains, aircraft, convoys, and commercial trucks, and satellite-enabled tracking systems provided logisticians visibility on items to the last tactical mile.”³⁸ During Iraqi Freedom, there were between 50,000 and 60,000 US and UK pallets and containers tracked monthly using active RFID and more than 500 ground-based nodes that could read and write active RFID data in the CENTCOM area of responsibility. Worldwide, it is estimated the DoD’s current RFID network manages and monitors 270,000 cargo containers transporting military supplies through 400 locations in more than 40 countries.³⁹

Even though the DoD’s use of RFID technology significantly increased between the Gulf War and Iraqi Freedom, the DoD is not satisfied with the results. On 2 October 2003, the Under Secretary of Defense for Acquisition, Technology and Logistics (USD AT&L) issued a policy letter to describe how the DoD will pursue active and passive RFID in the future. The letter initiated the strategy that integrates RFID technology use throughout the DoD. The policy and accompanying strategy is in five parts.

- The policy directs the continued use of active RFID tags to support ongoing combatant commander ITV requirements and operations.
- The policy requires DoD suppliers to put passive RFID tags on the lowest possible piece or part, case, or pallet packaging.
- The policy directs that DoD components establish an initial capability to read passive RFID tags at key sites in preparation for passive RFID implementation.
- The strategy establishes a DoD RFID integrated product team and directs the team to achieve five goals:
 - Evaluate and inform the applicable DoD components of RFID standards.
 - Implement initial RFID projects to demonstrate possible technical applications.
 - Conduct an RFID summit to solicit comments on the policy from suppliers.
 - Complete an analysis on the initial projects to identify lessons learned.
 - Provide a final RFID policy and strategy to the DoD.
- The letter describes implementation and integration of the first four parts as critical elements for the future success of systems development across the DoD. However, USD AT&L does not provide any additional funding. USD AT&L suggests the DoD components consider these RFID requirements in their near-term budget adjustments and in their long-term requirements when developing upcoming service and agency budgets.⁴⁰

The USD AT&L policy letter goes a step further and identifies six layers or supply chain item movement locations, where the DoD expects to use RFID tracking in the future. The layers include:

- Layer 5—the movement vehicle truck, aircraft, ship, or train
- Layer 4—the freight container 20- or 40-foot container or 463L pallet
- Layer 3—unit-loaded assets warehouse pallets, fiberboard packaging

- Layer 2 – the transport unit carton, boxes
- Layer 1—in bubble packs
- Layer 0—at the product item

DoD’s goal is to use RFID technology to track items at each layer.⁴¹ Additionally, the USD AT&L letter identifies and directs DoD organizations that are responsible for providing the warfighting combatant commanders active RFID support. First, TRANSCOM was directed to ensure US and overseas aerial and seaports, both military and commercial, that support military operations have the necessary equipment to meet the RFID read-and-write requirements. Second, the USD AT&L identified the specific military departments responsible for ensuring sufficient RFID equipment is available to support each of the combatant commander’s military plans and operations.

Although it is not mentioned in the USD AT&L policy letter, DLA, as the responsible organization for RFID technology within the DoD, is pursuing technologies to further integrate RFID capabilities into the DoD’s global ITV network. DLA is working with industry to develop the strategies and capabilities to enhance the DoD’s supply chain infrastructure; this effort is ongoing at DLA via a program called Microchip Logistics (MICLOG). The goal of MICLOG is to integrate active and passive RFID technologies into DLA’s RFID management structure. Once MICLOG is implemented, DLA is expected to have insight into item movement down to Layer 0.⁴² Additionally, DLA hopes that private sector business practices will demonstrate the real impact of using RFID technology. A study by the global consulting firm Accenture concluded that RFID technology can lower inventories by at least 5 percent, to as much as 30 percent.⁴³ RFID could have a major impact on DLA’s immense logistics enterprise. DLA manages 4.6 million items, processes 30,000 requisitions daily, and has an inventory valued at \$80.5B.⁴⁴ Using Accenture’s 5-percent estimate, DLA can expect to save more than \$4B against its \$80.5B inventory. If DLA can reduce its inventory by 30 percent, its savings could be more than \$24B.

The newly minted policy from USD AT&L makes it clear the DoD is committed to incorporating both active and passive RFID technology into its global supply chain as quickly as possible, and as the policy letter states, implementation of RFID is critical if the DoD’s Logistics Transformation is to occur.⁴⁵ And with \$4B to \$24B in possible savings, DLA stands to benefit tremendously from RFID technology. As the DoD and DLA prepare to move forward with incorporating RFID technology in the future, there are challenges that must be addressed to make RFID capabilities a reality for the DoD in the future.

Challenges

RFID is a relatively new automatic data-collection system, and like many computer technology-based systems, the technology is changing rapidly. Although RFID technology is a powerful data-collection tool, the DoD needs to recognize that, like all great ideas, there are challenges that must be met before the technological benefits can be recognized. Obsolescence, standardization, and interoperability are all critical challenges that affect the DoD’s use of RFID technology; currently, all three issues have an effect on DoD’s RFID technology implementation. Since the end of the Gulf War in 1992, RFID technology has

benefited the DoD tremendously. Because of these benefits, the DoD intends to capitalize on RFID technology and implement the technology in the DoD supply chain.

The DoD's current fleet of active RFID tags provides logisticians valuable insight into the global DoD supply chain. However, RFID, like most electronic systems, has a short technological life cycle, so the decision to purchase a system today can mean that you have an obsolete system within a few months. Currently, the DoD's active RFID tags have the capability to log and transmit logistics data as required in today's supply chain; however, since DLA made the decision to procure the standard active RFID tags, industry has developed additional capabilities that could prove beneficial to the DoD. The North River Consulting Group (NRCG) recently provided the Federal Highway Commission a report that identifies active RFID tag capabilities that are becoming available to freight transporters.⁴⁶ Since 1991, the railroad industry has been investigating automatic data-collection technologies that can enhance freight security and productivity.⁴⁷ Three of the technologies mentioned in the NRCG report can enhance the way the DoD uses active RFID tags to track an item's location and could prove beneficial to the DoD by incorporating the capabilities into the supply chain. The report indicates that active RFID tags that can sense temperature changes, detect vibrations, and monitor security breaches are *in the works*.⁴⁸ Tags that can monitor temperature

preference. With a host of vendors, the state of RFID frequencies is in disarray because there is no one standard; the systems that exist for rail, truck, air traffic control, and tolling authorities can all be—and most are—on different frequencies.⁵⁰ The lack of frequency standardization is a global challenge, and frequency regulatory differences between countries are pretty much nonexistent. As a result, there is no single frequency available for logistics applications across the major theaters of Asia, Europe, and North America.⁵¹ With regard to interoperability between RFID tags with tag readers, currently, there is no universal standard for reading encoded information from active or passive RFID tags or a standard for encoding tags. As a result, problems develop when vendors build RFID tag readers. Vendors easily can design readers for their specific tag; however, organizations like the DoD then would be limited to a sole supplier for all RFID applications. With a multitude of global vendors supplying RFID technology, the scenario of procuring various vendors single source technology will not work in the real world.

As an example, these nonstandard and noninteroperable RFID technology challenges could have an effect on the DoD's ability to conduct successful US-only and multicountry coalition military operations in the future. During Iraqi Freedom, the UK's decision to procure the same active RFID capabilities as the United States paid off big.

The lack of frequency standardization is a global challenge, and frequency regulatory differences between countries is pretty much nonexistent.

changes could prove useful in establishing an audit trail and assigning liability for temperature sensitive cargo. Likewise, having an active RFID tag that can detect vibration if a pallet or container is dropped by a shipper or determine if a cargo container is opened while in transit could prove to be an invaluable tool for DoD supply chain ITV. It is apparent that active RFID technology capabilities have improved significantly since DLA made the decision to procure the DoD's standard active RFID tag, and it is possible that these new capabilities can be integrated into current active RFID tag capabilities to address the obsolescence in technology found in today's DoD active RFID tags that only provide item location updates. It is possible these new capabilities could be incorporated into the DoD's supply chain to provide valuable ITV information

Even with the new active RFID capabilities, there are two major challenges associated with RFID technology that must be addressed before widespread use of the technology takes hold. The lack of RFID frequency standardization and interoperability problems associated with RFID readers and tags from different vendors are two challenges that are slowing RFID growth worldwide.⁴⁹ With respect to frequency standardization, most RFID vendors offer proprietary systems, which results in RFID frequencies' being selected for tags based on a vendor's

They decided to implement the same RFID technology that the United States is using.... They had an incident where they could not find a tank track that had been ordered. So they made plans to place a second order, but someone suggested trying to find it with the ITV system. They found it, and it saved them about \$3M in cost avoidance.⁵²

Because the United States and United Kingdom fought as a close-knit coalition during Iraqi Freedom, the decision to procure a similar RFID system probably was easier than most coalition decisions. But the scenario raises the question: in the future, will the US coalition partners pursue the same RFID technology as the United States? The US coalition partners' decision on RFID technology, like major weapon systems they purchase, most likely will be driven by how the DoD proceeds with RFID. With common US and coalition military systems, like the F-35 joint strike fighter, where multiple countries will use the same airframe and where parts are manufactured and shipped from global sources, it is possible that, during future military operations, the United States or a coalition country will need a part from the other's *parts bin* to make an aircraft mission capable. To make an aircraft mission ready quickly, a possible scenario might be for a US logistician to request a coalition partner to look in its ITV system to determine if it has a needed part in the supply chain headed for the area of operations. Without RFID

standardization and interoperability, this scenario would be a dismal failure. The only way for the DoD to ensure that its vendors, parts suppliers, and global coalition partners all have the same RFID capability to encode and read active and passive RFID is to work toward universal frequency standards and interoperability between RFID readers and tags.

Recommendations

Information technology is a key enabler for managing the Defense Department's vast transportation continuum and is the linchpin for defense logistics distribution in peace and war.

—General John W. Handy, USAF

It is important to examine the next step the DoD should take in pursuing active RFID and how the DoD should proceed in addressing the challenges of active and passive RFID standardization and interoperability. A recommendation for how the DoD should proceed with integrating RFID technology will be presented after evaluating three alternative options. Each option identifies both negative and positive impacts the DoD will experience if the course of action is selected (Table 1).

Option 1

The DoD should continue with its present plan to integrate passive RFID technology into the supply chain and continue to use its current active RFID technology. A negative impact to this approach is the DoD cannot be sure the nonstandard and noninteroperable challenges affecting passive and active RFID technology will be corrected in time for its implementation in January 2005. Furthermore, by not implementing new active RFID capabilities, the DoD will not be able to benefit from the advanced technologies that are available. A positive impact to this approach is that guidance already has been distributed to the appropriate organizations within the DoD and to its suppliers on the plan to implement passive RFID. As a result, the DoD is on its way to implementing a passive RFID capability in 2005. Additionally, the active RFID technology in use within the DoD's supply chain has been successful in providing item tracking at the container and pallet levels. If the DoD does not implement new active RFID capabilities, the capabilities that exist still would be beneficial.

Option 2

The DoD should continue with its present plan to integrate passive RFID technology into the supply chain and move forward with acquiring new active RFID technology. As with Option 1, a negative impact to this approach is the DoD cannot be sure the nonstandard and noninteroperable challenges affecting RFID technology will be corrected in time for implementation of passive or new active RFID capabilities. A positive impact to this approach is that the DoD can incorporate enhanced active RFID capabilities to build smarter supply chains. New active RFID technology is available to be incorporated into the DoD's supply chain. Temperature sensing, vibration detection, and security monitoring can provide significant insight into and productivity gains to the DoD's supply chain, and the new capabilities can be integrated into active RFID tags to address obsolescence.

Option 3

The DoD should move ahead slowly with integrating passive RFID technology and new active RFID technology into its supply chain. Using this approach, current active and passive RFID standardization and interoperability challenges can continue to be addressed and a solution found. To date, a consortium of 87 global companies and 3 research universities has joined in a partnership with the Uniform Code Council and European Article Numbering International to address RFID challenges and develop global RFID standards.⁵³ The consortium, known as the Auto-ID Center, is developing international RFID standards for infrastructure, data formats, and frequencies.⁵⁴ The center was developed by visionaries who are intent on keeping the individual companies from spending millions of dollars to develop new RFID technology by having all the companies invest in the development of new RFID, with the hope the global community accepts the center's technology as the industry standard.⁵⁵ To ensure savings for all, the Auto-ID Center's research has support from global manufacturers and retailers so that companies worldwide can be assured the final RFID products developed by the center will be standard and interoperable. Wal-Mart, a partner in the Auto-ID Center, is adopting the universal RFID standards that are being developed at the center, so much so that it recently requested that its top 100 suppliers put passive RFID tags on all shipping crates and pallets in 2005. This move by Wal-Mart likely will force the adoption of RFID capabilities worldwide because of its market clout.⁵⁶ Because of this same clout, DoD representatives met with Wal-Mart's vice president for Global Supply Chain Management to discuss the RFID technology.⁵⁷ The meeting provided the DoD an opportunity to hear from the retail leader how industry will pursue RFID technological challenges, and it served as an impetus for the DoD. It probably is not a coincidence that the USD AT&L policy letter directs DoD's suppliers to provide a passive RFID tag capability in 2005—the same as Wal-Mart.⁵⁸

There are two impacts that may affect the DoD negatively by waiting to implement new RFID capabilities. First, logisticians responsible for DoD SCM will have to wait to track items successfully down to the tactical level using passive RFID technology. Waiting means the DoD will conduct business as usual and continue to use active RFID technology to track items at the strategic level. Second, waiting to incorporate new capabilities into active RFID tags will mean that tags in the current inventory must be available longer. Because these tags have a limited life because of their battery, some tags will have to be replaced while the DoD waits to purchase the new, smarter active RFID tags; however, the cost to replace current active tags

Option	Passive RFID	Active RFID
1	DoD should implement USD AT&L policy requiring suppliers to use passive RFID tags by January 2005.	DoD should continue to use current active RFID tags, as suggested in USD AT&L policy.
2	Same as Option 1	DoD should integrate new active RFID capabilities now.
3	DoD should wait until 2007 to integrate passive RFID capabilities.	DoD should wait until 2007 to integrate new active RFID capabilities.

Table 1. Passive and Active RFID Options Summary

because of battery failure can be viewed as a requirement for doing business. Even if the DoD decided not to purchase new active RFID capabilities, replacing a portion of the current tags at a cost of \$105 each would be a necessity.⁵⁹

On the positive side, there are two significant impacts to the DoD for waiting to implement approved RFID specifications. First and foremost, allowing time for the Auto-ID Center to address and correct the standardization and interoperability challenges that affect passive and active RFID technology will be most beneficial to the DoD. The *wait time* will ensure the DoD does not start with or continue to use a nonstandard and noninteroperable capability, which will require starting over when an approved capability becomes available. Second, one of the biggest barriers that is not allowing widespread adoption of e-tagging, using passive RFID, is costs.⁶⁰ It is expected that, starting in 2007, e-tagging will evolve into a widespread phenomenon because the cost of passive RFID tags will drop significantly.⁶¹ Today, the least expensive passive RFID tags available cost more than 30 cents; however, manufacturing technology is moving toward the development of extremely inexpensive tags. It is expected, "in August 2007, simple passive e-tags will sell for 5 cents or less."⁶² A 25-cent costs savings per passive RFID tag can result in significant savings to the DLA and commercial industry. If each of the 4.6 million items managed by DLA is fitted with a passive tag, waiting until 2007 to integrate passive RFID capabilities could result in \$1.15M in savings.⁶³ The result is even more substantial for commercial industry; it is estimated 14 companies that are members of the Auto-ID Center would consume 412 billion RFID tags each year to tag every object they produced. Waiting until 2007 to fit all the items with 5-cent tags could result in \$103B in savings.⁶⁴

Recommendation

Option 3, which suggests that the DoD move ahead slowly with its plan to integrate passive and new active RFID technology into its supply chain, is recommended. The DoD should ensure that current RFID standardization and interoperability challenges are resolved before directing the additional use of RFID technology. The DoD's directing its suppliers to use passive RFID by early 2005 is a bit premature. The DoD is endorsing nonexistent RFID standards effectively. As an alternative to current RFID guidelines, the DoD could adjust the USD AT&L policy by implementing a gradual integration approach. The DoD could use the early 2005 date for suppliers to provide passive RFID capabilities as a test of capabilities only. Once approved standards are released, the DoD can direct its suppliers to conform. While adjusting the USD AT&L passive RFID policy, the DoD could modify USD AT&L's active RFID strategy by requesting that suppliers provide enhanced and backwardly compatible active RFID tags for assessment in 2005. The DoD then could evaluate the new active RFID capabilities and, if deemed satisfactory, plan for a preplanned product improvement program to replace all active RFID tags in the future.

In addition to revising USD AT&L's 2 October 2003 policy and strategy, the DoD should perform a cost-to-benefit analysis to determine the amount that can be saved by waiting until 2007 for universal RFID standards and lower passive RFID tags. These cost savings should then be weighed against the DoD's benefit of having a passive RFID capability in 2005 with tags that may have to be replaced once universal RFID standards are in place.

Integrating RFID capabilities into the DoD's supply chain would clearly benefit logistics sustainment system transformation; however, there are significant drawbacks to implementing RFID technology prematurely. A study by Gartner Research provides a timetable for standardized and interoperable RFID; "e-tag standards and technology will mature so that inter-enterprise applications will be viable from 2007."⁶⁵ Postponing implementation of RFID technology will have negative and positive impacts on the DoD logistics supply chain; however, the positive impacts far outweigh the negatives. It is wise for the DoD to move forward in transforming its logistics support systems; however, it is unwise to move forward until approved and tested RFID technology standards are in place.

Conclusion

RFID technology is a critical capability needed by the DoD to transform its logistics support systems to meet future challenges and provide both warfighters and logisticians Total Asset Visibility. Both active and passive RFID technology can be used as transformation tools to provide valuable insight into DoD's global logistics supply chain and ensure the leaner and lighter military forces have the sustainment items needed when required to protect the country's national interest. To take advantage of RFID's technological innovations, the DoD has developed a strategy that will infuse RFID capabilities throughout the DoD's logistics supply chain. The DoD's desire to transform its logistics sustainment system is noteworthy; however, it is important for the DoD to proceed with caution with RFID integration because of the considerable challenges with RFID obsolescence, nonstandardization, and noninteroperability. Commercial industry is addressing the RFID challenges, but universal RFID standards will take time. There will be growing pains with integrating RFID because of the challenges with its new technology, but the positives far outweigh the negatives. The DoD should continue to participate with the commercial consortia and standards organizations aimed at developing international standards for RFID technology and implement the RFID technologies once universal standards have been approved. In the end, RFID technology will be a boon, rather than a burden, for the DoD. Ultimately, the capabilities provided by RFID technology will benefit the DoD and commercial supply chains worldwide.

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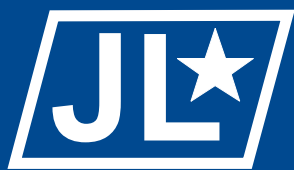
Lieutenant Colonel Davis is Commander, 552^d Maintenance Operations Squadron, Tinker AFB, Oklahoma. At the time of the writing of this article, he was a student at the Air War College, Maxwell AFB, Alabama, and Colonel Jones was on the staff of the Air War College.



notable quotes

...I have dared to look into the future, but that in so doing I have based my views, not on idle imaginings, but upon the reality of today, out of which grows the reality of tomorrow.

—Giulio Douhet



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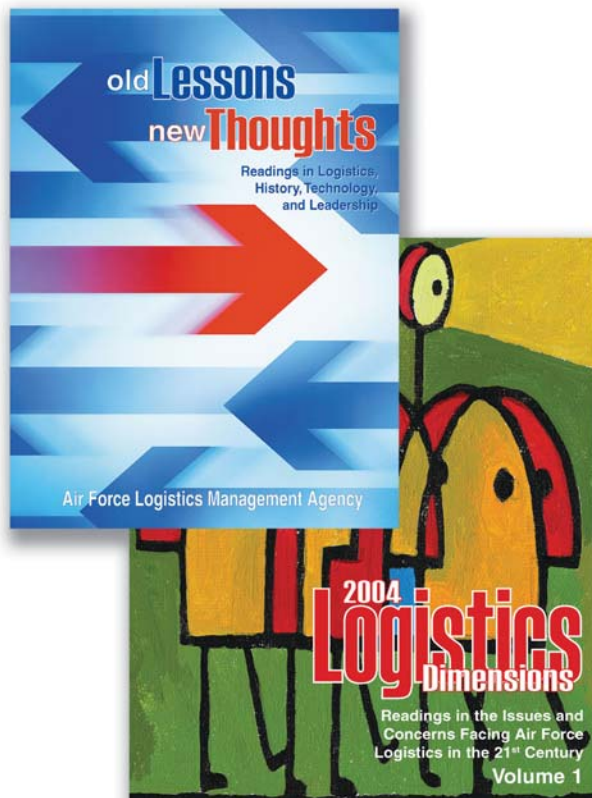
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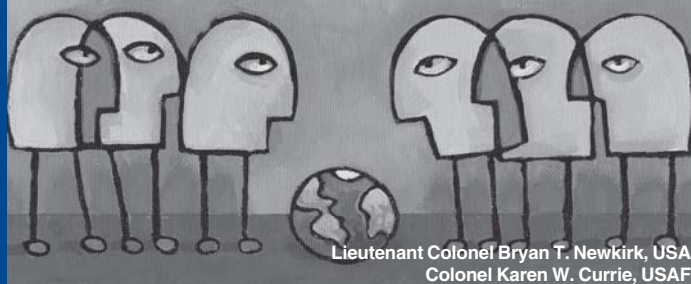
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